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HOUSE OF COMMONS SESSION 1995–96

SCIENCE AND TECHNOLOGY COMMITTEE

First Report

TECHNOLOGY FORESIGHT

Volume I

Report and Minutes of
Proceedings

Ordered by The House of Commons *to be printed*
29th November 1995

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The Science and Technology Committee is appointed under Standing Order No 130 to examine the expenditure, administration and policy of the Office of Science and Technology and associated public bodies.

The Committee consists of 11 Members. It has a quorum of three.

The Committee has power:

(a) to send for persons, papers and records, to sit notwithstanding any adjournment of the House, to adjourn from place to place, and to report from time to time;

(b) to appoint specialist advisers either to supply information which is not readily available or to elucidate matters of complexity within the Committee's order of reference;

(c) to communicate to any other such committee and to the Committee of Public Accounts and to the Deregulation Committee its evidence and any other documents relating to matters of common interest; and

(d) to meet concurrently with any other such committee for the purposes of deliberating, taking evidence, or considering draft reports.

Unless the House otherwise orders, all Members nominated to the Committee continue to be members of it for the remainder of the Parliament.

The following were nominated Members of the Committee on 13 July 1992:

Mr Spencer Batiste
Dr Jeremy Bray
Mr Malcolm Bruce
Mrs Anne Campbell
Cheryl Gillan
Mr William Powell
Sir Giles Shaw
Sir Trevor Skeet
Dr Gavin Strang
Sir Gerard Vaughan
Dr Alan W Williams

Sir Giles Shaw was elected Chairman on 15 July 1992.

On 9 November 1992 Mr Malcolm Bruce was discharged and Mr Andrew Miller added to the Committee

On 16 November 1992 Dr Gavin Strang was discharged and Dr Lynne Jones added to the Committee.

On 7th November 1995 Cheryl Gillan and Mr William Powell were discharged and Mr Ian Bruce and Mr Patrick Thompson were added to the Committee.

The cost of printing and publishing this Volume is estimated by HMSO at £2,540.

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FIRST REPORT

TECHNOLOGY FORESIGHT

The Science and Technology Committee has agreed to the following Report:

INTRODUCTION

1. In the White Paper "Realising our Potential" published in May 1993 the Government announced that:

> "Technology foresight, jointly conducted by industry and the science and engineering communities, will be used to inform Government's decisions and priorities."[1]

The fundamental objectives of the Foresight programme are:

(i) "to encourage closer interaction and networking between the science, engineering, academic, business and Government communities;

(ii) to build a common understanding between these communities of the challenges, concerns and emerging opportunities in markets and technologies;

(iii) to provide broad guidance on priority areas of SET [Science, Engineering and Technology] which have emerged from the consultative process so that these may be taken into account by the Government as a whole, individual Departments of Government, Research Councils, Higher Education Funding Councils, and industry."[2]

2. The Technology Foresight programme may be divided into two parts. The first, which has already been completed, might be termed the "survey" of current capabilities and future needs and we will refer to it as the Foresight Survey.[3] This was supervised by the Technology Foresight Steering Group, under the chairmanship of Professor Sir William Stewart, the then Government Chief Scientific Adviser (CSA). The Steering Group was made up of representatives from government, industry and academe. It decided to conduct the exercise through a series of fifteen panels, some dealing with particular user groups (eg. construction) and some with technologies (eg materials). These panels were each made up of about twenty members, drawn from industry, the public sector research community - including the universities - and in some cases the civil service. These groups of experts identified technological needs and technological possibilities in their field and made recommendations, both in research programmes and in the infrastructure for research, for their own sector. The Steering Group set out the terms of reference for the panels, kept a broad oversight of their activities and ultimately produced its own report identifying priorities for United Kingdom research and technology as a whole.

3. The Foresight Programme was not intended to end with the publication of the reports of the sector panels and Steering Group; indeed, in the Foreword to the Steering Group report Professor Sir William Stewart said that the Government had intended to do two things "First, form the networks which will perform Foresight on a continuous basis over the coming years; and second, take positive action on our science, engineering and technology priorities in the light of Foresight findings."[4] Nor are the recommendations of the Steering Group aimed at government alone; they affect industry and the public sector research base as well as almost all government departments. If Foresight succeeds it will have an immense influence on our future national prosperity. It therefore seemed appropriate to undertake a short inquiry into Technology Foresight with the aim of reporting before the Government finalised its proposals

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[1] Cm2250, para 1.18.

[2] *Partnership Through Progress: The Report from the Steering Group of the Technology Foresight Programme 1995*, OST May 1995, p.98, para 5.3.

[3] This term covers the whole process whereby the Steering Group and Sector panels gathered this information and produced their reports; it is not the Delphi Survey, which was a mere part of that process.

[4] *Partnership Through Progress*, p.v.

for implementing Foresight, which are to be published shortly.

4. In the course of this inquiry we have received over seventy-five submissions from industrialists, learned societies, research councils and academics. We have held four sessions of oral evidence. In the first of these we took evidence from The Rt Hon Ian Lang MP, President of the Board of Trade, Mr Ian Taylor MP, the Minister for Science and Technology, Professor Robert May, the Chief Scientific Adviser and Professor Sir John Cadogan, the Director General of the Research Councils. In later sessions we examined witnesses from the Centre for Exploitation of Science and Technology (CEST), Dr Elves and Dr Whelan, officials from the Office of Science and Technology (OST) and Department of Trade and Industry (DTI), Mr Stewart Miller of Rolls Royce, Mr John Bennett, Secretary General of the Association of Independent Research and Technology Organisations (AIRTO), Professor Sir Geoffrey Allen FRS, Professor Peter Day FRS, Director of the Royal Institution; Dr Alan Rudge, Deputy Group Managing Director of British Telecommunications (BT) and Chairman of the Engineering and Physical Sciences Research Council (EPSRC) and Dr David Clark, Director of Planning and Communication of the EPSRC, and representatives from the CBI, Dr Brian Eyre, Dr Stewart Judd and Dr Philip Wright. We are very grateful to all those who gave us evidence, both written and oral. In the course of this inquiry we were helped by our Specialist Adviser, Professor Derek Burke, whose assistance we very much appreciate.

5. In this Report we consider first the transfer of the OST to the DTI, which occurred at the commencement of our inquiry. We then turn to the conduct of the Foresight survey and the future of Foresight. We conclude with an examination of the "Forward Look of Government Funded Science, Engineering and Technology 1995" (the "Forward Look").

THE CONTEXT OF THE INQUIRY

6. Shortly after we decided to conduct this inquiry the context of our investigation was changed by the announcement of the transfer of the Office of Science and Technology from the Cabinet Office to the Department of Trade and Industry. We accordingly invited comment on this change in our call for evidence.

7. We asked many of those who gave oral evidence what they considered to be Government's role in funding science and technology.[5] There was a broad consensus in their answers. The function of the science base was considered to be to provide a research infrastructure which would primarily consist of trained and creative people. The definition of this research infrastructure varied - Professor Day referred to "custodians of knowledge at the absolute cutting edge of the discipline in which they work";[6] Dr Elves called for less exclusive skills and also drew attention to the need for up to date equipment;[7] Dr Eyre, appearing for the CBI, drew attention to the Government's role in providing an appropriate regulatory framework - a concern shared by many witnesses.[8] However, there was general agreement that government funded research was intended "to build the core technological competence of the nation".[9] There was also agreement that industry had prime responsibility for carrying out the process of innovation.[10]

8. Some of the concerns expressed about the transfer of the OST to the DTI are similar to those expressed about the Foresight Programme and, indeed, about the policies set out in the 1993 White Paper, "Realising our Potential". There is a concern that too vigorous an emphasis on the importance of the application of science to industry could diminish the amount of support available to the basic science which will produce the "core technological

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[5] QQ128-134, QQ191-196, QQ390-391, Q329.

[6] Q192.

[7] QQ129-134.

[8] Q390.

[9] Q329.

[10] Q391.

competence" identified by our witnesses as essential for the industrial innovation of the future.[11]

9. **There was no clear consensus about the merits of the transfer of OST to DTI. While witnesses hoped that bringing the DTI and the OST together would increase the standing of the OST within Whitehall, ensure that the DTI came to an increased appreciation of the importance of science and technology and improve communications between the research base and industry, there were fears that the reverse would be the case and that the new position of the OST within the DTI would in fact lead to a decline in its effectiveness.[12] We acknowledge that the transfer of the OST from the Cabinet Office to the DTI could bring a more integrated system in which the White Paper priorities of increasing the links between academe and industry can be carried out. We consider that it is desirable to ensure that the science base and industry are engaged in constructive dialogue and that much publicly funded research should be directed to topics where industry might have an interest. However this is not to say that the science base should act as a research consultancy dedicated to industrial problem solving. Some public sector science is, quite properly, directed to ends for which there is no commercial justification and should remain so. The challenge for the DTI will be to demonstrate that it understands this crucial distinction.**

10. After the transfer was announced the Government made attempts to clarify the position and allay the scientific community's concern. The Director General of the Research Councils circulated a letter explaining that "the functions of the OST are ring fenced within the DTI."[13] The Prime Minister wrote to the Chairman of the Committee that:

> "OST's responsibility for co-ordinating science, engineering and technology policy across Government will be maintained. The Chief Scientific Adviser will continue to have direct access to me as well as heading the OST. The Director General of Research Councils will have direct access to Ian Lang as Cabinet Minister responsible for Science and Technology. The Science Budget will be handled as a separate head within DTI's expenditure programme."[14]

The status of the President of the Board of Trade as "Cabinet Minister for Science" was emphasised.

11. When we took evidence from the President of the Board of Trade we attempted to clarify these points. The division of responsibilities between the President and his colleague, Mr Ian Taylor MP, the Minister for Science and Technology, does indeed appear clear. Asked who was Minister for Science, Mr Lang replied "In the Cabinet context I am; in the day to day Government context, Mr Ian Taylor is."[15] Provided that the President of the Board of Trade devotes the necessary time to science and technology this division may be satisfactory. We are encouraged by Mr Lang's participation in the debate on science and technology policy on 20th October 1995 and his assertion that he regarded representing science in Cabinet as "an important priority".[16] However we note that he is likely to have less time for science than his predecessors whose responsibilities were centred on the Office of Public Service and Science.

12. Doubts remain over the extent to which the OST will retain its independence and, in particular, the extent to which negotiations over its spending plans will remain separate from negotiations over other parts of the DTI budget. Although the President of the Board of Trade assured us that there should be no reduction in the science budget "as a consequence

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[11] See, for example, TFC 46, TFC 50, TFC 52, TFC 54.

[12] See for example, TFC 3, TFC 5, TFC 9, TFC 13, TFC 34, TFC 35, TFC 36, TFC 39, TFC 40, TFC 45, TFC 58, TFC 74, TFC 75.

[13] Deposited in the Record Office.

[14] Deposited in the Record Office.

[15] Q6.

[16] Q5.

of the changes in the governmental structure"[17] and that the OST and DTI budgets would be "separately discernable"[18], he could give no assurances that the two would be separately negotiated with the Treasury.[19]

13. A major concern, which was expressed by many industrialists, was that the DTI would be tempted to direct science base research to short term measures, rather than encouraging the basic research "on which the applied research in industry can be built."[20] Some witnesses suggested that as the DTI had not appreciated the value of its own research portfolio, it was unlikely to champion that of the OST.[21] Indeed, there was a danger that the science base could be encouraged to perform the industrially related research which had previously been performed by the DTI.[22]

14. We share the concern about the DTI's past treatment of its own research base. The shift of policy from direct support of technology to promoting technology transfer or technology awareness and industrial innovation is one with which this Committee might agree. However, we note that Professor Robert May, the Government Chief Scientific Adviser, told us some of the decline in departmental spend "represents ... a real loss".[23] Nor has money previously devoted to industrial research simply been transferred to other forms of support for innovation. There has been real decline in the resources the DTI has devoted to science and technology (which includes innovation policy) over the period covered in the "Forward Look", and this expenditure is projected to decline still further.[24]

15. The other major concern our witnesses expressed was that a move to the DTI would diminish the OST's ability to carry out co-ordination of policy across Whitehall. The Royal Academy of Engineering, which was conscious of the advantages of the transfer, also warned:

> "The status of OST is diminished. Its extraordinary nature and priority are no longer credible and it is now just another subsidiary element of the DTI."[25]

"Science and technology policy" is not a purely departmental responsibility; it is a crucial factor in national success to be considered and implemented by government as a whole. It is accordingly important that the OST does not come to be seen as simply a subsidiary component of the DTI, but we fear it may be hard to prevent this.

The Transdepartmental Role of the Chief Scientific Adviser

16. The Government Chief Scientific Adviser (CSA) will have prime responsibility for ensuring that the transdepartmental issues in science and technology policy are properly explored; we trust that the OST will be so structured as to support him in this. We welcome the fact that, in evidence, the President of the Board of Trade made it clear that Professor May's role was unchanged from that of his predecessor, who was, of course, located in the Cabinet Office.[26]

17. We would have more confidence in the DTI's strategy if the post of DTI Chief Scientific Adviser had not been discontinued. The DTI, excluding the OST, still commands the highest budget for science and technology of any civil department other than the OST

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[17] Q31.

[18] Q28.

[19] Q29.

[20] TFC 76, see also, for example, TFC 3, TFC 34, TFC 52, TFC 53.

[21] TFC 14, TFC 26.

[22] TFC 26.

[23] Q36.

[24] *Forward Look of Government-Funded Science, Engineering and Technology 1995*, HMSO, Volume 3, Table 2.2.

[25] TFC 74. See also TFC 14, TFC 30, TFC 34, TFC 46, TFC 58, TFC 70.

[26] Q5.

itself and the Department for Education and Employment.[27] Indeed, as we said in our First Report of Session 1993-94:

> "The DTI has a crucial role in the interface between government and industry. Even if it provided no direct funding for innovation at all it would still need to understand industry's innovation needs ... We are accordingly concerned that the DTI's decision to discontinue the post of Chief Scientific Adviser will weaken its ability to act as an informed listener."[28]

Given that the Government Chief Scientific Adviser has a prime responsibility for transdepartmental science and technology issues, we repeat our concern at the lack of a Chief Scientific Adviser or Chief Scientist within the Department of Trade and Industry itself and recommend that the post be recreated.

18. It would, in our view, be equally unsatisfactory if Professor May was drawn into the position of acting as *de facto* Chief Scientist for the DTI. His wider responsibilities for science and technology policy in general and the Technology Foresight programme should occupy him fully. There would also be organisational difficulties if Professor May were to take on this role; his departmental concerns would conflict with his wider responsibilities in a way which would be most clearly demonstrated in the science committee of officials, which is made up of departmental chief scientists.[29] He could not be expected to combine his responsibilities as Chairman of this Committee, by right of his post as government CSA, with a departmental role. Equally, it is important that the CSA should retain his present right to report both to the Prime Minister and to the Cabinet Minister for science even if a DTI Chief Scientist is appointed.

19. **The appointment of a chief scientist to the Department of Trade and Industry would indicate that the department was aware of the distinction between the OST's transdepartmental responsibilities and overall responsibility for the science base and the specific research and innovation policy for which the DTI proper is responsible.**

20. It is too early to judge whether the transfer of the OST to the DTI will be a success. Future PES settlements, which we will scrutinise, will show whether the fears that science base research will suffer from the transfer or become directed towards programmes formerly carried out in departmental research establishments are well founded. Most of all, however, we will be concerned to ensure that the OST retains its transdepartmental role and that the responsibility for the health of the research base directly funded by government and for fostering a climate conducive to innovation is not lost sight of amidst a plethora of conflicting departmental priorities.

THE CONDUCT OF THE TECHNOLOGY FORESIGHT SURVEY

The Scope of the UK Programme

21. Technology Foresight is not new. Since 1970, the Japanese have conducted the most extensive Foresight process in current use; every five years Japan's Science and Technology Agency[30] conducts a "Delphi survey" in which questionnaires on a great number of topics (1,149 in the most recent exercise) were sent to several thousand experts who:

> "were asked to assess (for those topics with which they were familiar) the likely timing of each technological advance or innovation, its probable economic or social importance, whether there was a need for international joint development, where Japan stood in terms

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[27] *Forward Look*, Vol. 3, Table 3.1.

[28] *The Routes Through which the Science Base is Translated into Innovative and Competitive Technology*, HC(1993-94)74-I, para 329.

[29] This continues to exist in spite of the absorption of the Cabinet Committee for Science into the Cabinet Committee on Competitiveness. Q21.

[30] The 1992 survey was conducted by the National Institute for Science and Technology Policy and the Institute for Future Technology.

> of R&D level compared with other countries, and the likely constraints to be encountered in realising that technological development or innovation."[31]

There is then a second stage at which the results are fed back to the experts for further discussion. The Reports provide background material for both government and industry and the process is judged to have been a success.[32]

22. Other countries have also introduced their own foresight activities; an account of these is given in an essay by Ben Martin, an advisor to the Technology Foresight Steering Group.[33] In most cases they build on the Japanese model, and may even use direct translations of the questions used in the Japanese Delphi Survey. As the Steering Group noted, Foresight exercises have been undertaken in Australia, Germany, the USA and the Netherlands.[34]

23. Foresight has also been carried out in the United Kingdom before now. Many large firms and industrial associations conducted Foresight exercises, and the Research Councils conducted systematic consultation exercises to determine their priorities.[35]

24. The Steering Group accordingly had a great deal of background information to draw upon. The United Kingdom Foresight exercise was particularly ambitious. While other countries have simply used the Japanese Delphi Questionnaire as the basis for consultation, the sector panels were each asked to construct their own set of questions for a new Delphi survey. In addition they were encouraged to use "scenario planning" a method by which a number of possible futures are envisaged (for example, both a low inflation and a high inflation economy) in an effort to identify courses of action which would be advantageous whatever the external events. Moreover this extremely complex and sophisticated activity was to be completed in a very short time. The Steering Group was established in 1993; the sector panels were appointed in 1994; the panel reports were published between March and April 1995 and the Steering Group's Report was published on 22 May 1995. In the year in which the sector panels were active "Views from some 10,000 people were canvassed through: a large scale Delphi Survey; 60 regional workshops; conferences and other events; interviews; written submissions; and various interactions with relevant overseas bodies".[36]

The results of the Foresight Survey

25. There was general agreement that the government led Technology Foresight Survey was "timely"[37], "welcome" and "long overdue".[38] The extent of consultation alone was far larger than that available in private sector or Research Council exercises and even when the survey revealed little that informed insiders had not already known about each sector or technology it provided valuable confirmation of existing research priorities.[39]

26. The scale of the exercise, which meant that the results covered a far greater range of topics than those generated by smaller exercises, was particularly valuable.[40] It is increasingly difficult for practitioners to gain information about work in areas other than their own. Through the Foresight survey industrialists and academics gained an insight not just into informed opinion in their field but in other related fields; indeed the process highlighted possible connections between fields previously regarded as distinct from one another. For example, the Agriculture, Natural Resources and Environment panel, the Chemicals panel,

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[31] Ben Martin, *Technology Foresight 6: A Review of Recent Overseas Programmes*, HMSO, 1995, p.10.

[32] See, for example, TFC 9.

[33] *Ibid.*

[34] *Progress Through Partnership*, p.18, para 2.1.

[35] See, for example, TFC 40, TFC 47, TFC 68.

[36] *Progress Through Partnership*, p.23, para. 2.7.

[37] TFC 35.

[38] TFC 38, see also, TFC 13, TFC 14, TFC 25.

[39] See, for example, TFC 1, TFC 17, TFC 25, TFC 34, Q149.

[40] TFC 34.

the Defence and Aerospace panel, the Energy panel, the Manufacturing, Production and Business Processes panel, and the Materials panel all recommended that research into sensors was needed; this alerted the Steering Group to a new priority for generic research.[41]

27. However there was also agreement that the programme was, or had the potential to be, more than the sum of its parts. As the Engineering and Physical Sciences Research Council (EPSRC) said:

> "The unique contribution brought by the national Technology Foresight Programme has been to introduce a coherence and consistency of approach across the entire range of science, engineering and technology. This high profile given to the programme by the UK Government helped ensure that a considerable number of key individuals in both industry and the university sector devoted a significant amount of time and effort to the programme."[42]

We were most impressed by the commitment to Foresight expressed by the great majority of our witnesses.

28. The ambitious nature of the Foresight exercise, and the timescale in which it was conducted inevitably led to problems.[43] There were criticisms that the study threw up few real surprises; that younger researchers and those with iconoclastic views were not consulted, and that while the reports appeared exhaustive they might nonetheless rest upon a partial study of their field.[44] However, it was also conceded that there was a need to ensure that the programme did not lose impetus, and that expectations were not dissipated by long delays.[45] **We consider that the completion of the first survey stage of the Foresight Programme within two years was a remarkably impressive achievement. While we agree that the speed with which the exercise was accomplished led to some flaws in the process, we consider that the need to develop and maintain interest in the programme justified the timetable chosen for this first major Foresight exercise.**

THE FUTURE OF FORESIGHT

29. A Foresight exercise has two types of result. The first is largely intangible. The survey process itself should have stimulated wide ranging thought and debate about the future possibilities open to both science and industry. Moreover, in bringing people together to do this, useful networks should have been formed between individuals involved in many different aspects of research and its exploitation.

30. The second set of results is the recommendations made by the sector panels and Steering Groups. Implementation of many of these recommendations will, it is hoped, improve the United Kingdom's competitiveness. The outputs of Foresight may be quite different for industry and the public sector; industry should gain from the information in the Steering Group and sector panel reports, and from the networks that Foresight should foster. It is to be hoped that Foresight will also inform industry's own research, but here the Foresight findings cannot be expected to over-ride the commercial judgement of the individual firm.[46] Government Departments and Research Councils should have the benefits that Foresight will bring to industry, but they, in addition, will have the prime responsibility for the implementation of the detailed recommendations of the Steering Group and in focusing "limited research funds into areas which by consensus with industry should at least increase the probability of commercial success".[47]

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[41] *Progress Through Partnership*, pp.47, 49, 55, 57, 69, 71, 81, see also TFC 21, TFC 34.

[42] TFC 22.

[43] See, for example, TFC 8, TFC 29, TFC 30, TFC 51, TFC 74.

[44] TFC 1, TFC 10, TFC 31, TFC 71.

[45] TFC 56, TFC 65.

[46] See TFC 9.

[47] TFC 9.

31. It will, in years to come, be relatively easy to return to the recommendations made by the Steering Group and sector panels and determine the extent to which they have been implemented. The relative ease with which this can be done may lead to undue emphasis on such concrete recommendations rather than on the less tangible achievements such as improving awareness of science and technology within industry and fostering networks. Foresight must be judged by its ability to meet *both* sets of objectives. In some sense the initiative has already been a success; as the Construction Industry Council said:

> "The precise details of the process do not matter. What was significant was that it happened and that a large commitment was made by many key people."[48]

The Steering Group and Sector Panels

32. The Steering Group recommended that the Steering Group and sector panels should be retained to ensure that networks were sustained and Foresight findings disseminated.[49] The OST has accepted this and given the panels the following key objectives for the next twelve months:

—to disseminate panel findings throughout the relevant industry sector;
—to continue to develop the networks on a regional and national basis;
—to promote implementation of findings by brokering partnerships between firms and with Research Councils, Departments and Universities;
—to monitor progress with Research Councils and Departments as appropriate; and
—to keep panel recommendations under review and assess them in the light of community views.[50]

33. There was general agreement that the continued existence of the Steering Group and sector panels was sensible.[51] It would ensure that the intangible benefits of the Foresight process were sustained, would provide informed people to disseminate information, and would ensure that there was continuing pressure for the implementation of panel findings.[52] **We support the OST's decision to continue the Steering Group and the sector panels.**

34. However, we have some concerns about the way in which this is being implemented by the OST. Panels are likely to change in future, and their terms of reference include provision for the appointment of new members by panel chairmen.[53] We appreciate that membership of the panels requires a great deal of commitment and that there will inevitably be some turnover in membership as panellists return to their primary responsibilities in industry or academe.[54] Nonetheless, **sector panels need to have a membership stable enough to ensure they are capable of reviewing their findings and to ensure that members are committed to the recommendations they seek to implement.**

35. There is also a difficult balance to be kept between ensuring that the Panels retain continuity between different parts of the Foresight process and ensuring that the system does not become ossified as technology changes around it. We appreciate the responsiveness to informed opinion which led the OST to substitute an Agriculture Panel and an Environment and Natural Resources Panel for the combined Agriculture and Natural Resources Panel, which was criticised as having too wide a remit.[55] We also support the formation of a Marine Panel and understand the reasoning behind the merging of the IT and Communications panels. Nonetheless, we **agree that, as the Steering Group noted, "we would wish to see structural modifications to the panels kept to a minimum in order to maintain maximum**

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[48] TFC 29.

[49] *Progress Through Partnership*, p.99, para 5.5.

[50] TFC 1, Annex E.

[51] Q354, TFC 29, TFC 40.

[52] Q357, Q428.

[53] TFC 61, Annex E.

[54] Q270.

[55] TFC 5, TFC 21, TFC 33, TFC 48.

continuity with the first phase of the programme."[56]

36. The Steering Group will also be of great importance in the next phase of Foresight. The sector panels will have a great deal of responsibility but the Steering Group must monitor the extent to which the panels are fulfilling their remit and must ensure that cross-disciplinary issues are properly considered.[57]

37. The membership of the Steering Group and sector panels will affect their ability to perform their tasks. While witnesses were content that panel chairmen were being given the power to appoint panel members, since they should be well placed to identify those with suitable expertise, there was also agreement that this would only be satisfactory if the Steering Group were given a responsibility to monitor the composition of the panels to ensure they did not become dominated by coteries or special interests.[58] One of the key tasks of the panels will be to form and maintain networks and they will need a balanced membership if they are to do this.[59] **We recommend the Steering Group be given specific responsibility for oversight of panel membership.**

38. The Steering Group has been reconstituted to "reflect the need to focus on dissemination and implementation in a wider community".[60] The individual appointments are unexceptionable. However, the NFU noted the removal of biologists from the panel and told us:

> "The contribution of biological sciences to the agricultural industry and to the British economy is substantial and is likely to become increasingly more important in the next century. We are very concerned that this important area is not going to be given the representative voice on the committee that it clearly deserves."[61]

39. This places a heavy burden on Professor May, who does have wide ranging biological expertise but also has many other responsibilities, and one of the Steering Group's Expert Advisers, Dr Anderson of the Wellcome Trust. There are fewer members of the Steering Group able to cover Agriculture, Food and Drink, Health and Life Sciences, and Natural Resources and Environment, areas which between them count for at least 11 per cent of GDP, than are available for any comparable group of panels. The Steering Group cannot duplicate the sector panels, and there is no need for each "sector" to have a Steering Group member to represent it, but such a lacuna may prevent it from carrying out its oversight role effectively. We also note that none of the industrialists on the Steering Group comes from an industry which rests upon the life sciences. **We recommend that serious consideration be given to adding someone with expertise related to the sectors underpinned by biological science to the Steering Group.**

Networks

40. In our First Report of Session 1993-94 we noted:

> "it is helpful to think of each innovation as the product of an 'innovation network'. These networks will vary immensely. In a very few cases they may be relatively straightforward connections between a public sector research institution and a company which will more or less conform to the linear model. More frequently, they will be complex systems in which information is widely exchanged. 'Innovation networks' rest on a series of other networks; among these are the simple networks within companies, or within individual universities or laboratories; the trans-institutional and international networks of those interested in particular research areas; and the networks between customers and

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[56] *Progress Through Partnership*, p.100, para 5.8.

[57] TFC 33.

[58] Q371, Q428.

[59] QQ353-4.

[60] TFC 66, para 5.5.

[61] TFD 78.

suppliers."[62]

We concluded that to "innovate successfully a company or individual must have access to ... a wide range of expertise or networks."[63] We continue to believe that as science and industry become increasingly global and the techniques they use become increasingly interdisciplinary access to such networks will be vital. **We were pleased to note that almost all our witnesses commented favourably upon the Foresight survey's role in constructing networks between many of the producers and consumers of research.**[64]

41. **The Steering Group and sector panels should be at the heart of the networking process. Much of the responsibility for the dissemination of Foresight has been laid upon them. We agree that they are crucial to the process.**

42. We were told of many instances in which industrial societies or learned bodies were actively collaborating with the OST to disseminate and implement Foresight results.[65] There has also been interaction between members of the sector panels and other groups conducting foresight activities. For example, when the Institute of Materials conducted its own Foresight activity it kept in close touch with the OST and made the Chairman of the Materials panel a member of its Steering Committee.[66] **We welcome the participation in networks demonstrated by the OST and members of the sector panels and Steering Group and recommend that it continue. The OST should regard itself as an active participant in the Foresight process, not just an overseer.**

43. We were however disturbed to hear concerns that too little effort had been applied to maintaining such networks between the publication of the Panel and Steering Group Reports and the beginning of our inquiry.[67] There does seem to have been a hiatus between May and late September, when neither the Steering Group nor the panels appear to have met formally. It is true that this coincided with the recruitment of a new CSA (who took office several months after his predecessor had left it) and also the move of the OST into the DTI. But this was a crucial period, and impetus was slowed for administrative reasons within the OST. Ultimately networks must be fostered by those who are most likely to benefit from them. But government plays an important enabling role, especially in the early stages of a new process. Industry and academe have already made a major commitment and it was therefore important that the OST maintained the commitment and coherence of the Steering Group and panels.

Dissemination

44. Industry will only be able to act upon the suggestions and recommendations made in the Foresight Reports if it is aware of them. Dissemination of Foresight results will be crucial to the long term success of the entire programme. Such dissemination should also, in itself, help to create and sustain the networks which have been identified as so important.

45. There is some concern about who should bear responsibility for dissemination of Foresight results. Some of our witnesses felt that the Government had not accepted this responsibility as fully as it should.[68] The Construction Industry Council told us that "There is no alternative to a sustained "campaign" orchestrated by Government".[69] Several witnesses pointed out the need to ensure that Foresight findings were promulgated both by national and by regional organisations.[70]

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[62] HC(1993-94)74-I, para 50.

[63] Ibid, para 52.

[64] See, for example, TFC 14, TFC 17, TFC 30, TFC 34, TFC 35, TFC 50, TFC 73, Q353.

[65] See, for example, TFC 48, QQ162-170, Q402.

[66] Q232.

[67] Q150, Q408, Q412, see also *"Turning Foresight into Action"*, A CBI Position Paper, July 1995.

[68] TFC 31, TFC 42, TFC 53, Q408.

[69] TFC 29.

[70] Q402, TFC 70.

46. The DTI has set aside £2 million for disseminating Foresight results and encouraging take up of priority recommendations and both sector divisions and regional offices are assisting the panels in this task.[71] This activity is largely targeted at the concerns of small and medium sized enterprises. The OST itself is working with many non-governmental bodies; as we were told:

> "It is likely that Government is not best equipped to deliver Foresight ideas to corporate targets; and it will increasingly look to non-governmental deliverers (including business schools, the universities, CEST[72], RTOs[73] and other consultancy organisations), with a direct financial interest in selling Foresight as a useful strategic tool, to convey the Foresight message to business."[74]

Many industrial associations and learned societies have been promulgating the Foresight results. For example, the CBI has held conferences and seminars on Foresight[75] and the Centre for the Exploitation of Science and Technology has not only produced a booklet, "Acting on Foresight", for its members but offers a series of events to explain Foresight which can be tailored to the individual company's concerns.[76] The most recent issue of "Foresight News" announces that the Institute of Physics has launched a £26,000 project, jointly funded by the DTI, to disseminate and evaluate recommendations from the Foresight survey.

47. **We have been impressed by the willingness of industrial and professional bodies and learned societies to play an active part in the dissemination and evaluation of Foresight results. We agree that it is appropriate for the DTI and OST to provide financial support for this activity.**

48. However, there is some criticism of the dissemination methods chosen. Not only was there widespread concern about the hiatus in the Foresight process mentioned above, Dr Elves, Chairman of the Research Committee of CEST, felt that "these were activities which should have been placed in hand earlier", to increase the chance of success,[77] and the CBI suggested that the OST lacked any overall communication plan which would ensure the information given was consistent.[78]

49. We are not overly concerned about lack of consistency in the presentation of Foresight findings. The results of the sector panels, and even of the Steering Group report, will need to be evaluated not only by those working in specific areas of each sector but by individual firms and researchers. Dissemination of the findings should be the opening of debate, rather than the presentation of an action plan.

50. We would however be concerned if the effective dissemination of findings were unduly dependent on the willingness of non-governmental groups within each sector to take responsibility for it. As Mrs Williams of the OST told us:

> "Ultimately it has to be up to the private sector to respond to the Technology Foresight reports, but we see a role for OST and the Government and for the panels in stimulating that response, particularly in those sectors which traditionally have not had close links to the science base or in the smaller companies which equally need to be led towards a more innovative way of thinking."[79]

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[71] TFC 61, para 5.17.

[72] The Centre for Exploitation of Science and Technology.

[73] Research and Technology Organisations.

[74] TFC 61, para 5.21.

[75] TFC 53.

[76] Q128, TFC 42.

[77] Q150.

[78] TFC 53, paras 13-14.

[79] Q301.

We recommend that the Steering Group monitor the extent to which Foresight findings are disseminated in particular sectors by the panels and that the OST, together with the DTI, should be prepared to act directly if particular sectors or types of company are ill provided for.

Finance

51. In the past we have been concerned that the United Kingdom's financial system does not adequately support innovation.[80] One problem often identified was poor communication between industry and its financiers and a lack of mutual understanding.[81] For this reason **we welcome the appointment of an Executive Director of the Bank of England to the Steering Group and we recommend that the OST and DTI ensure that members of the financial community are involved in local and regional initiatives to disseminate Foresight findings.**

52. However, as we noted previously, the barriers to the successful financing of innovation are not caused by poor communication alone. In our Report on "The Routes Through which the Science Base is Translated into Innovative and Competitive Technology"[82] we stated:

> "We have concluded that the financial system in the United Kingdom produces a culture which is risk averse and inclined to rely too heavily on short-term financial measures. Behaviour that is rational for those in the financial market place can have destabilising effects for industry. This is beyond the power of any one agency to change but we believe that, if UK industry is to flourish, the financial system will have to adapt positively to seek partnership with innovative industry. At present it has neither the risk acceptance of the United States system nor the patience of the German and Japanese systems."[83]

We strongly support the Steering Group's recommendation that further research be undertaken to understand the managerial and financial approaches to the containment of business risks associated with innovation.[84]

Implementation of Foresight Recommendations

53. Although the debate that Foresight should provoke will be valuable in itself, the recommendations of the Steering Group and the sector panels will also need to be implemented. There was some concern expressed that the recommendations might be implemented unthinkingly. Several witnesses pointed out that not only had the exercise been conducted at great speed, its findings were conditioned both by the division of the field into the particular sectors chosen and by the people appointed to the sector panels.[85] For these reasons, many witnesses suggested that the findings be re-evaluated. Others felt that it was essential that impetus was maintained and that the recommendations should be implemented as speedily as possible.[86]

54. Implementation and review are not, of course, mutually exclusive, and the sector panels are to "keep panel recommendations under review and assess them in the light of community views".[87] However, the main emphasis of the next phase of the initiative will be on implementation. This must be correct; further attempts to refine the recommendations would simply ensure that the survey part of the Foresight process became unceasing. It is only in attempts to encourage government, the research community and industry to implement the

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[80] First Report from the Science and Technology Committee, HC (1993-94) 74-I, paras 188-259.

[81] *Ibid*, paras 215-216.

[82] HC(1993-94)74-I.

[83] *Ibid*, para 10.

[84] Progress Through Partnership, p.112, para 5.31.

[85] TFC 10, TFC 65.

[86] Q157, Q268.

[87] TFC 61, Annex E.

recommendations that any deficiencies will be discovered. Accordingly **we agree that the next phase of the programme should focus on implementation. However such implementation should not preclude continuous assessment of the original recommendations, and a willingness to adapt or even abandon them in the light of experience.**

Implementation in Government

55. The Foresight programme produced two types of recommendations aimed at government and the science base. The first might be termed technical, and are concerned with the identification of areas into which the Research Councils and research sponsoring departments might direct their research and ways in which interaction with industry might be encouraged. The second type of recommendation was described by the OST in their memorandum as "infrastructural issues", and covers a wide area including education and training, regulatory and economic issues.[88] **In our view, the "infrastructural issues" identified by the Steering Group report are the most significant. Successful innovation is more likely to be encouraged by ensuring that the networks between industry and academe are functioning correctly, and the financial and regulatory climate is conducive to innovation, than by identifying particular research topics.**

56. Each Government department has a Foresight Action Manager and in addition a "Whitehall Foresight Group", consisting of these managers, has been established "to co-ordinate responses to the infrastructural priorities in the Steering Group's Report."[89] The OST told us:

> "It is expected that the Group will focus particularly on those areas where Government has a particularly strong locus, namely, in the areas of communications, education and training, finance and the policy and regulatory framework."[90]

but warned that some recommendations "may require further discussion before specific work can be initiated."[91] As Mrs Williams said:

> "Some of the infrastructural issues which the Foresight reports raise are almost intractable issues which will take some time for government departments to get their minds round."[92]

57. Our witnesses agreed that the recommendations on infrastructural issues, especially those relating to regulation, were particularly important. However, there were some scepticism about the likelihood of their implementation.[93] **The success of the Whitehall Foresight Group in identifying measures to improve the climate for innovation in the United Kingdom and implementing those measures will be a key indicator of the extent to which the OST can co-ordinate transdepartmental policy from within the DTI.**

Implementation of Foresight in the Science Base

58. Some witnesses were concerned that the health of the science base could be damaged by the need to consider Foresight priorities[94] and by related policies directed toward increasing the interaction between industry and academe. Professor Peter Day suggested that new products were developed from scientific breakthroughs so fast that a Foresight process could not predict them.[95]

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[88] TFC 61, see also TFC 53.

[89] TFC 61, para 4.6.

[90] TFC 61, para 4.7.

[91] TFC 61, para 5.15.

[92] Q293.

[93] See, for example, TFC 26, TFC 27, TFC 38, TFC 50, TFC 53, TFC 74, QQ142-3, QQ343-5, QQ396-7.

[94] Q200.

[95] QQ197-199, see also TFC 50.

59. Dr Alan Rudge, the Chairman of the Engineering and Physical Sciences Research Council (EPSRC), explained that the EPSRC used Foresight as one factor considered when the Research Council determined the allocation of funds within broad research topics. Once those allocations were made and promulgated, it was up to individual researchers to put forward research proposals within those topics. There was also provision for funding proposals which had no relationship with Foresight.[96] Dr Rudge told us the EPSRC spent time "trying to map the broad areas" of research that would enable the Council to meet Government policy "that research should not only be excellent but also relevant".[97] The Council then went out to "the academic community and ask for 50 per cent of our projects to be covered by them for projects or for suggestions within these very broad maps".[98] The Higher Education Funding Councils are also re-considering the allocation of funds between particular subjects in the light of the Foresight results.[99] Dr Rudge considered there was no problem in using Foresight to set some broad research priorities in this way.

60. However, Dr Rudge did consider that problems could be caused if the OST succumbed to the temptation to speed up the process by transferring resources to particular research programmes rather than letting the Research Councils use Foresight to determine their general priorities. Such a transfer would leave the Research Councils under-resourced.[100] We share his concern. We were also troubled by suggestions that Research Councils should be able to show that their spending priorities had been changed by Foresight.[101] As Dr Clark, Director of Planning and Communication of the EPSRC, told us, the EPSRC has been in dialogue with those conducting Foresight since it was established in 1994; we do not believe it is atypical in this.[102] Research Council priorities already show the influence of Foresight. **We consider that it is reasonable to ask Research Councils to demonstrate that some expenditure is allocated to broad Foresight priorities, but Foresight should not be used in too directive a way. We note that the Steering Group recognised that not all the Research Councils' priorities would be identified through Foresight.**[103]

61. We were encouraged by the Director General of the Research Council's assertion that while the Research Councils should take Foresight into consideration, "they will not be dominated by Foresight"[104] and that even if something were Foresight related it would only be funded if of high quality.[105] **We agree that there is no intrinsic reason why Foresight should affect the health of the science base, providing that the Government retains a commitment to fund the highest quality science and accepts that not all spending should be aligned to Foresight.**

Links between Science and Industry

62. The Government has long had initiatives to encourage closer links between science and industry through the promotion of collaborative research. The three which have most relevance to Foresight are the LINK scheme, the Realising our Potential Awards (ROPAs), and the Foresight Challenge Awards.

63. New LINK schemes have already been established in a number of priority areas identified by Foresight, and the funding for two existing schemes has been increased.[106] We had been concerned about reports of delay and undue bureaucracy in approving projects for

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[96] Q330, Q360, Q366.

[97] Q330.

[98] Q330.

[99] TFC 23, TFC 64, TFC 67.

[100] Q369.

[101] TFC 53.

[102] Q360, see also Q365.

[103] *Progress Through Partnership*, p.110, para 5.30.

[104] Q44.

[105] Q45.

[106] TFC 61, para 4.4.

LINK funding which threatened to reduce its effectiveness.[107] We were pleased to be told that although LINK had not operated effectively in the past, this had now been remedied.[108] Witnesses from both EPSRC and CBI considered the scheme to be effective and useful.[109]

64. The Realising our Potential Awards are intended to encourage academics to collaborate with industrialists. They provide funding for projects, however speculative, chosen by the researcher, but only those who have succeeded in attracting £25,000 of support from industry for basic or strategic research are eligible to apply. There has been some criticism of these awards on the grounds that they are likely to be open only to older researchers, since young ones will not have obtained the necessary sponsorship, the schemes supported may be of low quality, and that they may displace funding for conventionally peer-reviewed projects of higher priority.

65. Dr Rudge and Dr Clark explained that although ROPA applications were not peer reviewed in the conventional sense, they were subject to quality controls.[110] The recent "Report on Initial Experiences with the 'Realising our Potential Award' Scheme" found that some members of the assessment panels were not aware of the extent to which they had discretion to assess the applications made to them.[111] We support the recommendation made in that Report that:

> "the ROPA Working Group should consider how to amend the ROPA Guidelines, so as to clarify how the criteria of originality and technical feasibility are to be interpreted, and that in any future rounds of ROPAs, clearer guidance should be given to panel members on their freedom for action."[112]

We consider that while ROPAs may not be subject to conventional peer review they should only be awarded for high quality proposals.

66. ROPAs currently account for 1.7% of the Science Budget.[113] The future of the scheme is not yet decided, although some awards made this year will run until 1998-99.[114] The scheme must inevitably exclude younger researchers without industry links, and the quality of the research sponsored by ROPAs will not be proven for some years. Moreover money spent on ROPAs in future is likely to reduce the funds available for other Research Council priorities. **We recommend that expenditure on ROPAs, as a percentage of the Science Budget, should not be significantly increased until the scheme is proven.**

67. The Foresight Challenge Awards were announced on 22nd May and launched on 25th September. The Challenge will "offer funding, on a competitive basis, to collaborative projects which take forward either generic or sectoral priorities."[115] The public sector contributions to a Challenge project must not exceed 50 per cent, except for projects in the field of training.[116] Some witnesses were concerned that the Government did not appreciate the cost of secondments to industry; while we are pleased that contributions may be made in cash or in equivalent material resources we consider there is a case for extending this to allow some of the costs of personnel to be included.[117]

68. £40 Million has been made available for the Challenge awards; this should be matched

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[107] TFC 76.

[108] Q377, Q404.

[109] Q377, QQ407-8.

[110] QQ375-6.

[111] OST/DTI, 19 October 1995 (hereafter *ROPA Report*) p.20, para 85.

[112] *Ibid.*

[113] *Ibid*, p.12, table 5.

[114] *Ibid*, p.12, para 38.

[115] TFC 61, para 4.5.

[116] *Ibid*, Annex C.

[117] See TFC 30, TFC 73, Addendum III to TFC 53 (which has been deposited in the Record Office).

by an equivalent sum from industry. The intention is that the money should not be spread too thinly. Mrs Williams told us the OST was "thinking in terms of tens or scores of projects rather than hundreds."[118] There will be two rounds for the awards. Outline bids in the first round had to be submitted last month and the first awards are expected to be made in March 1996. The second call for projects is expected in June 1996. No decision has been made as to what proportions of the Challenge fund will be allocated to each round.[119]

69. We were encouraged to learn that some of our witnesses already knew of bids to the fund,[120] but we are somewhat concerned at the extremely tight timetable for the first round of awards. The second round is intended to satisfy the demand for:

> "a slightly less ambitious timetable in fields where collaborative partnerships are comparatively novel;
>
> a timetable which accommodates organisations whose budgetary planning cycles have made it difficult for them to participate in the first round."[121]

One of the aims of Foresight has been to encourage companies which may not be "technologically aware" to become so, and to encourage new collaboration between the public and private sectors.[122] Such new collaboration will, as the OST recognises, take some while to arrange. While mediocre projects should, of course, be rejected, **we recommend that at least a third of the budget for the Challenge Awards be reserved for second round proposals. High quality proposals which could not be funded in the first round could be reconsidered in the second.**

70. When we read the description of the Awards Scheme we were concerned that the Challenge Awards Group, which is to consist of the CSA, the DGRC, the Chairman of the LINK board, and two members of the Technology Foresight Steering Group,[123] might be too limited in numbers and expertise to perform the task adequately. Mrs Williams of the OST explained:

> "It is not the intention that the Challenge Awards Group ... should do all the assessment themselves, although they are responsible for making the final recommendations to Ministers. We expect that they will want to draw on advice from relevant research councils, from the relevant sector panels and it is also planned that the Challenge Awards Group should discuss their shortlisting of projects with the Technology Foresight Steering Group, so I think we have actually built quite a number of checks and balances into the process."[124]

We consider that as long as the Challenge Awards Group takes sufficient advice from research councils and sector panels the mechanisms for making the awards should be satisfactory. The Challenge Award scheme is a new mechanism for supporting technology transfer and its operation will be watched with interest.

Resources

71. There was much criticism that the administrative resources allocated to the survey itself had been inadequate.[125] The Natural Environment Research Council (NERC) considered that without greater support the process would run the risk of being "data rich and information

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[118] Q308.

[119] TFC 61, Annex C.

[120] QQ227-8, Q430.

[121] TFC 61.

[122] See TFC 40.

[123] TFC 61, Annex C.

[124] Q304.

[125] TFC 31, TFC 68, TFC 73, TFC 74.

poor."[126] The most telling criticism of the lack of administrative support, however, came from British Telecom, which remarked:

> "the Foresight process seemed insensitive to the amount of time and energy given in most cases by very senior ... representatives of UK industry which was offered free and in the best professional spirit for general UK benefit, but into an atmosphere of shortage of supporting administrative competence and budget."[127]

There was also criticism that the lack of financial support for panel members meant that smaller companies were effectively excluded from the process.[128]

72. When we took evidence from the OST we were told that the staff resources had been increased and administrative resources for the implementation phase were now adequate.[129] The OST staff resources had been increased from 15.3 in 1994-95 to 19.3 in 1995-96. Three extra posts had been created below Grade 7 and one at Grade 7.[130] The CBI was not convinced that the administrative and financial resources were satisfactory:

> "The evidence we have is that they have been under-resourced. It has taken them time to get up to any sort of speed in getting the dissemination process going. When you look at the resources they have got and you see the area they are covering, it does look on the face of it very thin."[131]

73. It is right that the OST should be prudent in its use of administrative and budgetary resources. For this reason we would not advocate the automatic payment of panel members. Nonetheless, Foresight is meant to be a major initiative which will have implications for both government and industry. **Industry support for Foresight, and willingness to implement the recommendations emerging from the survey, are likely to be undermined if the Government is not seen to be allocating the resources necessary to ensure the programme is a success. We recommend that future Foresight activity is adequately financed and supported, and that the OST should seek to establish the appropriate level of funding.**

FUTURE FORESIGHT SURVEYS

74. Some witnesses felt that Foresight should be evaluated before any repetition of the survey.[132] As one witness told us, the surest sign of Foresight's success will be a long term improvement in the United Kingdom's competitiveness.[133] Evidence of this will not be available for some time. The OST is working on measures to evaluate Foresight, including measures to determine the extent to which Foresight will lead to greater competitiveness, and we applaud this work.[134] However, we consider that one of the indicators of Foresight's success will be the degree to which participants are willing, or even eager, to repeat the process. We were impressed by our witnesses' widespread support for a repetition of Foresight. We hope the implementation period will be successful enough to ensure that this support remains.

75. While there was general support for a repetition of some survey activity, there was less consensus about how this should be carried out. There were a range of suggestions from biennial reviews of the recommendations made by each panel[135] to a full scale repetition of

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[126] TFC 68.

[127] TFC 66.

[128] TFC 30, TFC 73.

[129] Q311.

[130] TFC 61, Table 1.

[131] Q422. See also Q413.

[132] See, for example, TFC 19, TFC 35, TFC 56.

[133] Q412.

[134] TFC 61, paras 5.17 - 5.19. But see also Q292, Q297.

[135] TFC 43, TFC 58.

the exercise every five to ten years.[136]

76. There was, however, agreement that the recently completed survey had had two major faults. The first was the lack of time available for the exercise and the second was the way in which the Delphi survey was administered.[137] Both these should be corrected in any future exercise.

77. **We recommend that any future surveys should be given sufficient time to enable a more thorough consultation than was the case on this occasion.** It is impossible to predict how long would be appropriate; if Foresight activity between surveys proves useful a new survey could be completed more quickly than the original one. It is, however, important that the Steering Group and sector panels are not forced into a timetable they consider unsuitable.

Delphi

78. The Delphi survey was the aspect of the programme which attracted most criticism. Respondents told us that it was poorly conceived, the questions were such that it was impossible to respond to them in a sensible way, there were too many questions and that confidence in the system was further undermined by the fact that the first drafts of the panel reports were prepared before the results of the Delphi survey were known. [138]

79. Perhaps more seriously, many witnesses felt that the Delphi questionnaire had alienated its respondents rather than involving them in the Foresight process. Some went so far as to suggest the inadequacies of the questionnaire had undermined the credibility of the entire programme and of future Foresight surveys.[139] Dr Elves of CEST remarked "it will be some time before the folk memory of this particular process will be eradicated."[140]

80. However, PREST[141] of the University of Manchester, which was closely involved in designing and administering the Delphi surveys, defended the use of the method. In its memorandum it identified the control of the panels over the survey as one of the reasons why the questionnaires were so complex but concluded "these disadvantages were far outweighed by the key advantage that these were not questions formulated as part of an academic exercise but rather ... related directly to the Panel's concerns and priorities."[142]. PREST also claimed that "Despite vociferous complaints from the German scientific community at the time the [German] survey has become a best seller and is widely used by German firms".[143]

81. Although Mrs Williams contended the sector panels did have the results of Delphi before they prepared their final Reports, we note that the full results and analysis of the Delphi survey were to be published in November 1995. At the time we agreed this Report they were not yet available. It is too soon to tell whether the full analysis of the Delphi questionnaire will have the impact that PREST expects.

82. **We recommend that if there is any repetition of the Delphi process questionnaires should be more focused both in the questions themselves and in the respondents to whom they are sent; if a wide range of expertise is required it may be necessary to tailor the questions to different groups. It is also important that those asked to expend a considerable amount of time on the questionnaires should have the purpose of the exercise explained more clearly than seemed to be the case. More effort should be expended on ensuring the questionnaires go to younger researchers or those with**

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[136] See, for example, TFC 3, TFC 11, TFC 58.

[137] See paragraphs 78-84 below.

[138] See TFC 77, para 11.

[139] TFC 22, TFC 35.

[140] Q187. See also TFC 35, TFC 40.

[141] Policy Research in Engineering Science and Technology.

[142] TFC 77, para 10.

[143] TFC 77, para 6.

divergent views.

83. The Centre for Exploitation of Science and Technology suggested that the Delphi Survey should take place in the years between major surveys to ensure that panels had the results available to them in good time.[144] Although this would hinder the involvement of panels in drawing up the questionnaires themselves the suggestion has much merit. **We recommend that the OST gives serious consideration to the timing of any Delphi questionnaire used in any future Foresight Surveys. Panels should have received the fully analysed results of such questionnaires at an early stage in the survey process.**

84. We trust that Foresight will be a success, and as a result of that success survey activity of some sort will need to be repeated. We note that most respondents suggested Foresight surveys should be carried out every five years.[145] We do not presume to suggest the precise form of such a survey: the Steering Groups and sector panels will be better placed to do that. However, **we recommend that some overview is taken once a decade *at the least*. Although panels may refine their proposals and issue new reports in the intervening period, a large scale survey will bring to light any re-organisation of the panels which may be necessary. Moreover only a large scale survey will provide the overview of scientific and technological possibilities which has been so valuable a result of the first Foresight Survey.**

THE FORWARD LOOK OF GOVERNMENT FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY

85. The "Forward Look" presents an annual picture of the Government's entire expenditure on science, engineering and technology. Its introduction was one of the policies announced in the 1993 White Paper.[146] The Committee has decided, in principle, to examine each year's edition of the "Forward Look". In 1994 we reported on the "Forward Look" alone; given the intention of the Government to use the results of Technology Foresight to influence the "Forward Look", we decided to include this year's scrutiny of the document within the inquiry into Foresight.

86. The White Paper made it clear that the "Forward Look" "would draw on the findings of the Technology Foresight Programme."[147] The OST told us

> "We will be expecting departments in next year's "Forward Look" to give an account of how they are responding to the various recommendations of the Foresight reports that apply to Government departments."[148]

Dr Michael Elves considered that the "Forward Look" provided a satisfactory way to determine the extent to which departments were using Technology Foresight and told us that "we have the shop store counter laid out. We can now measure progress against what happens on it."[149] **The "Forward Look" should be a key tool in ensuring that the Foresight Programme is in fact implemented.**

87. At a late stage in our inquiry the OST told us that:

> "In planning for 1996, OST aims to build on previous work and to make the "Forward Look" more effective in its presentation and influence. In particular, we aim to produce a document which provides a clearer statement of the Government's strategy and key objectives for SET and the current and proposed measures for achieving them. It should focus on forward plans for expenditure, the policy developments which underpin them and

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[144] TFC 42.

[145] See, for example, TFC 16, TFC 22, TFC 31, TFC 35, TFC 38, TFC 43, TFC 44.

[146] *Realising our Potential*, Cm 2250.

[147] *Realising our Potential*, Cm2250, para 2.37

[148] Q289

[149] Q179.

> the extent to which they are meeting White Paper objectives. It should be fully informed and shaped by Technology Foresight findings and should report the work done on output measures and performance indicators. It will reflect the transfer of responsibility for science, engineering and technology policy to the DTI and the opportunities that this presents to exploit DTI's contacts with industry.
>
> We are still developing our thoughts on how these aims might best be achieved and discussing them with other departments; but the result is likely to be a shorter document, if possible a single volume of reasonable length. This may mean publishing a separate volume of statistical information; we are discussing the options with the Central Statistical Office. We are aware of the need to provide continuity in the data sets published and in the coverage of the document as a whole."[150]

88. We can see the advantages of a shorter "Forward Look", provided that it continues to fulfil its function and there is no diminution in its statistical content. There is much material, particularly in the first volume, that might be omitted. Some changes have already occurred. The lengthy essays on science and technology subjects, a feature of the 1994 "Forward Look", have this year been replaced by briefer descriptions of particular areas of Science and Technology research and policy, under the general headings: "SET White Paper in Action" and "Strategic Collaboration in SET between Departments". We do not consider this a loss. However, **given the importance of the "Forward Look", we expect the OST to consult its users, including this Committee, before any major changes are made.**

89. It would be helpful if a revised "Forward Look" contained figures that could more easily be related to the financial information given elsewhere. We tried, and failed, to relate the information given therein to that in the Department of Trade and Industry Expenditure Plans 1995-6 to 1997-98 (the DTI Annual Report)[151] We were particularly concerned by the figures given for industrial innovation in each document, which are as follows:

	1994-95 (£m)	1995-96 (£m)
DTI Annual Report	114.4	108.8
Forward Look	85.6	67.3

90. We asked the DTI to explain the relationship between Table 20.2 of the "Forward Look" and the table detailing expenditure on industrial research on page 61 of the DTI Annual Report, and to give a breakdown of Table 20.2 of the "Forward Look". We particularly wished for more information on the spending on collaborative projects such as LINK and EUREKA than was provided in either document. In our request we noted that allocations should have changed from the figures given in the DTI Annual Report as new funding had since been announced for implementing Foresight and supporting innovation.[152] The Department supplied, without clear explanation, a table based on that in the Annual Report from which it was possible to work out, with care, that the line for "Industrial Innovation" in the "Forward Look" was nearly equivalent to the line for "Industrial Innovation" in the DTI Annual Report, once support for "Technology Transfer, best practice and other innovation" was removed. It did not reflect the changes in plans announced this May. **We are deeply dissatisfied by the presentation of information on DTI expenditure on innovation in the DTI Annual Report, the "Forward Look" and in the written evidence we were given.**

91. The White Paper stated that, as the name suggests, the "Forward Look" would extend the old "Annual Review of Government Funded Research and Development", which it

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[150] TFD 79.

[151] Cm2804

[152] TFC 61

replaced.[153] However, while individual departments' entries do include general discussion of longer term plans under the heading "5-10 Year Perspective", no figures are given for specific science and technology programmes beyond those planned for 1995-96. The OST told us that:

> "In the case of government departments, their science and technology budgets are to be deployed in support of their various policy objectives which...vary from department to department. In most departments ... the decisions about S&T expenditure therefore follow policy ... what the outcome of those decisions will be in terms of the breakdown of S&T is not known more than about a year ahead."[154]

Nonetheless, some departments clearly do plan their expenditure over a longer time scale. For example, the Department of Environment, in its Annual Report, provides financial details for the Building Research Establishment (BRE) up to 1997-98; similarly, the Home Office in its Report details planned expenditure for the Forensic Science Service over the longer term. These are figures for research agencies, and it is regrettable that the "Forward Look" does not identify expenditure on such agencies. Other types of financial information are also omitted. Projected receipts for Launch Aid are given in the DTI Annual Report, but not included in the "Forward Look", even though the document contains a line on Launch Aid. This omission is particularly unfortunate since Launch Aid receipts are netted off against DTI science and technology expenditure: a sharp increase in receipts appears in the "Forward Look" as an unexplained and precipitous drop in expenditure. **We accept that it may not be possible for departments to give detailed breakdowns of all categories of future expenditure on science and technology. We nevertheless recommend that, at the least, the OST should require departments to provide those details of planned expenditure which are already available elsewhere. It would also be helpful to have clearer information about the way in which the figures given in the "Forward Look" relate to the figures given in other Government publications such as Departmental Annual Reports. Indeed, we are surprised that this has not already been done. This seems to be evidence that the transdepartmental co-ordination promised in the 1993 White Paper[155] is not working satisfactorily.**

92. We are also concerned about the inconsistency of the figures which are given in the "Forward Look". Mrs Williams told us:

> "Departments like MAFF or Environment or Transport are all using S&T for different policy purposes and it may be in the nature of the work they are supporting and the policy context that the amount of breakdown which is helpful or meaningful varies from one department to another."[156]

However, we would have expected departments to give details of expenditure on programmes such as LINK (in fact only the Department of Transport includes figures in its entry), since it is one of the means through which the Government pursues its policy of encouraging greater interaction between industry and the Science Base. **We recommend that there should be greater consistency in the presentation of information between departments and in particular that details of funding allocated to schemes such as LINK should be given.**

Format

93. The statistical supplement (volume 3) this year does not give the same lavishly presented material as last year. The actual statistical details are more or less the same as those given previously, but are presented with fewer and in some cases less helpful graphical illustrations; for example, the 1994 document detailed sectors funding work and those

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[153] *Realising our Potential*, Cm 2250, para 2.36.

[154] Q276.

[155] Cm2250, p.9.

[156] Q280.

performing it in a much clearer way than the equivalent table in the 1995 "Forward Look".[157] However, the cover price of this year's "Forward Look" has been reduced. **We consider it reasonable to economise on the presentation of information as long as there is no diminution in the document's content.**

94. This year, unlike last, there is no separate entry for the Higher Education Funding Councils (HEFCs). This omission was explained by Mrs Williams, who told us:

> "it was not possible to give the subject breakdown information for the new universities as for the old and for various reasons it was decided that we would ... not attempt to give a partial presentation of that information ..."[158]

We trust that complete statistics will be available next year and that the Higher Education Funding Councils will have a separate entry in the 1996 "Forward Look". The Higher Education Funding Councils provide a significant proportion of science base funding and the universities they support perform the vital task of providing scientific expertise. The document cannot give the overview that is intended without fuller information about the HEFCs.

Output measures

95. In our Report last year we said that we intended to review the progress the OST had made in devising output measures of the effectiveness of R&D. In particular we referred to total factor productivity[159] as an example of the type of measure which the OST should pursue.[160] This year's "Forward Look" says that "process measures" are being established by Departments and Research Councils who have:

> "examined the extent to which their SET programmes are subject to formal methods of research assessment; the mechanisms in place for consulting the users of research ...; mechanisms for promoting the commercial exploitation of research results ...; and, mechanisms for promoting improvements in the quality of life ... In addition ... the Government intends to give increasing attention to the primary outputs of research and how these are handled across the public sector."[161]
>
> and that;
>
> "The Government has also given consideration to the final outcomes of R&D ... for example, new and improved products and processes and cost reductions, qualitative improvements and increased effectiveness in the delivery of services."[162]

We are pleased that the OST is attempting to encourage the development of meaningful output measures. However, we are disappointed that our suggestion, that total factor productivity be investigated as a possible output measurement, has not been considered by the Government.[163] Accordingly, **we again recommend that the OST examine this particular method as a possible way of measuring the success of investment in Research and Development.**

The Committee's previous recommendations

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[157] See Figure 26 in the 1994 Forward Look as compared to figure 1 of the 1995 Forward Look.

[158] Q283.

[159] The ratio of outputs to the inputs of labour and capital.

[160] Second Report from the Science and Technology Committee, Session 1993-94, *The Forward Look of Government-funded Science, Engineering and Technology 1994*, HC(1994-95)422, para 48.

[161] *Forward Look of Government-funded Science, Engineering and Technology 1995*, Volume 1, paras 5.13 and 5.14.

[162] *Ibid*, para 5.15.

[163] First Special Report from the Committee, Session 1994-95. *The Government's Response to the Committee's Second Report, Session 1993-94, The Forward Look of Government-funded Science, Engineering and Technology*, HC 216, paras 44-47.

96. The Government Response to our Report on the 1994 "Forward Look"[164] promised a number of changes to the document. Most of these have been made. However, we note that our recommendation "that the historic figures for BERD[165] by industrial sector also be expressed in real terms in next year's issue of the Forward Look"[166] has not been put into effect, even though the Government said that it would reproduce in the 1995 "Forward Look" "real terms expenditure data by industrial sector (both civil and defence) for the three years 1990-1992."[167] Accordingly, **we again recommend that figures for BERD by industrial sector be expressed in real terms in next year's "Forward Look".**

97. The Government also undertook to provide "information on the total Framework Programme R&D funding received by UK institutions in the public and private sectors."[168] The 1995 "Forward Look" does not contain this information. The OST subsequently explained that it had not been possible to include these figures as they were not available in time, and that it would "expect to be able to publish a breakdown of the figures for 1993-94 in...the 1996 "Forward Look".[169] However, the figures given include only business enterprise, "old" universities and government departments and Research Councils. Figures for the "new" universities and for some other recipients, such as charities, are not available.[170] **We recommend that figures giving details of Framework funding received by institutions in the public and private sectors are published each year in the "Forward Look". The OST should also seek to improve the completeness and accuracy of these figures.**

98. We were also interested in the way in which contributions to European Union research and development expenditure were attributed to individual government departments. We were told that:

> "Attribution of the cost to the UK of EC R&D programmes is calculated each year on the basis of policy responsibility and is one of the inputs to the annual Public Expenditure Survey. This arrangement allows for EC expenditure on R&D to be taken into account in the expenditure discussions; but, because attribution is an input, not an adjustment made at the end of the Survey, there is no way of determining precisely its effect on the final provision for domestic S&T."[171]

However, we were given figures for the percentage attribution between the DTI proper, the OST and other government departments. These were as follows:

	1994 %	**1995** %
DTI (excluding OST)	60.6	57.7
OST (ie Science Budget)	13.5	13.5
Other departments/unallocated	25.9	28.8
TOTAL	100	100

We intend to monitor the division made in the attribution of the cost of EU R&D to departments in future. We recommend that this information is given in future editions of the "Forward Look."

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[164] *Ibid.*

[165] Business Enterprise Research and Development.

[166] HC(1994-95)422, para 27.

[167] HC(1994-95)216, para 16.

[168] *Ibid*, para 55.

[169] TFD 79

[170] *Ibid.*

[171] *Ibid.*

The Future of the "Forward Look"

99. It is obvious that more time is needed for the Technology Foresight Initiative to translate its results into changes which could be reflected in the "Forward Look"; next year's "Forward Look" should be in a position to reflect the results of Foresight more fully. **The comprehensiveness and clarity of the information contained in future "Forward Looks" will reveal the extent to which the OST can influence other departments. We consider it crucial that the OST is able to ensure that, as the White Paper said, "over time and reinforced by the results of the Technology Foresight Programme ... [the] ... new "Forward Look" will form the basis of better informed decisions between competing priorities, which can inform decisions taken during annual public expenditure surveys."**[172]

100. The "Forward Look" is intended to be a key document setting out the way in which science and technology expenditure has changed and is expected to change in the light of government policy.[173] The availability of the document has meant that the section of the Cabinet Office Departmental Annual Report devoted to the OST has been relatively brief. Yet although the Departmental Report is presented to Parliament, the "Forward Look" is not. **We recommend that in future the "Forward Look" should be laid before the House.**

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[172] *Realising our Potential*, Cm 2250, para 2.38.

[173] TFC 34.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

There was no clear consensus about the merits of the transfer of OST to DTI. While witnesses hoped that bringing the DTI and the OST together would increase the standing of the OST within Whitehall, ensure that the DTI came to an increased appreciation of the importance of science and technology and improve communications between the research base and industry, there were fears that the reverse would be the case and that the new position of the OST within the DTI would in fact lead to a decline in its effectiveness. We acknowledge that the transfer of the OST from the Cabinet Office to the DTI could bring a more integrated system in which the White Paper priorities of increasing the links between academe and industry can be carried out. We consider that it is desirable to ensure that the science base and industry are engaged in constructive dialogue and that much publicly funded research should be directed to topics where industry might have an interest. However this is not to say that the science base should act as a research consultancy dedicated to industrial problem solving. Some public sector science is, quite properly, directed to ends for which there is no commercial justification and should remain so. The challenge for the DTI will be to demonstrate that it understands this crucial distinction. (Para 9)

Given that the Government Chief Scientific Adviser has a prime responsibility for transdepartmental science and technology issues, we repeat our concern at the lack of a Chief Scientific Adviser or Chief Scientist within the Department of Trade and Industry itself and recommend that the post be recreated. (Para 17)

The appointment of a chief scientist to the Department of Trade and Industry would indicate that the department was aware of the distinction between the OST's transdepartmental responsibilities and overall responsibility for the science base and the specific research and innovation policy for which the DTI proper is responsible. (Para 19)

We consider that the completion of the first survey stage of the Foresight Programme within two years was a remarkably impressive achievement. While we agree that the speed with which the exercise was accomplished led to some flaws in the process, we consider that the need to develop and maintain interest in the programme justified the timetable chosen for this first major Foresight exercise. (Para 28)

We support the OST's decision to continue the Steering Group and the sector panels. (Para 33)

Sector panels need to have a membership stable enough to ensure they are capable of reviewing their findings and to ensure that members are committed to the recommendations they seek to implement. (Para 34)

We agree that, as the Steering Group noted, "we would wish to see structural modifications to the panels kept to a minimum in order to maintain maximum continuity with the first phase of the programme." (Para 35)

We recommend the Steering Group be given specific responsibility for oversight of panel membership. (Para 37)

We recommend that serious consideration be given to adding someone with expertise related to the sectors underpinned by biological science to the Steering Group. (Para 39)

We were pleased to note that almost all our witnesses commented favourably upon the Foresight survey's role in constructing networks between many of the producers and consumers of research. (Para 40)

The Steering Group and sector panels should be at the heart of the networking process. Much of the responsibility for the dissemination of Foresight has been laid upon them. We agree that they are crucial to the process. (Para 41)

We welcome the participation in networks demonstrated by the OST and members of the sector panels and Steering Group and recommend that it continue. The OST should regard itself as an active participant in the Foresight process, not just an overseer. (Para 42)

We have been impressed by the willingness of industrial and professional bodies and learned societies to play an active part in the dissemination and evaluation of Foresight results. We agree that it is appropriate for the DTI and OST to provide financial support for this activity. (Para 47)

We recommend that the Steering Group monitor the extent to which Foresight findings are disseminated in particular sectors by the panels and that the OST, together with the DTI, should be prepared to act directly if particular sectors or types of company are ill provided for. (Para 50)

We welcome the appointment of an Executive Director of the Bank of England to the Steering Group and we recommend that the OST and DTI ensure that members of the financial community are involved in local and regional initiatives to disseminate Foresight findings. (Para 51)

We strongly support the Steering Group's recommendation that further research be undertaken to understand the managerial and financial approaches to the containment of business risks associated with innovation. (Para 52)

We agree that the next phase of the programme should focus on implementation. However such implementation should not preclude continuous assessment of the original recommendations, and a willingness to adapt or even abandon them in the light of experience. (Para 54)

In our view, the "infrastructural issues" identified by the Steering Group report are the most significant. Successful innovation is more likely to be encouraged by ensuring that the networks between industry and academe are functioning correctly, and the financial and regulatory climate is conducive to innovation, than by identifying particular research topics. (Para 55)

The success of the Whitehall Foresight Group in identifying measures to improve the climate for innovation in the United Kingdom and implementing those measures will be a key indicator of the extent to which the OST can co-ordinate transdepartmental policy from within the DTI. (Para 57)

We consider that it is reasonable to ask Research Councils to demonstrate that some expenditure is allocated to broad Foresight priorities, but Foresight should not be used in too directive a way. We note that the Steering Group recognised that not all the Research Councils' priorities would be identified through Foresight. (Para 60)

We agree that there is no intrinsic reason why Foresight should affect the health of the science base, providing that the Government retains a commitment to fund the highest quality science and accepts that not all spending should be aligned to Foresight. (Para 61)

We consider that while ROPAs may not be subject to conventional peer review they should only be awarded for high quality proposals. (Para 65)

We recommend that expenditure on ROPAs, as a percentage of the Science Budget, should not be significantly increased until the scheme is proven. (Para 66)

We recommend that at least a third of the budget for the Challenge Awards be reserved for second round proposals. High quality proposals which could not be funded in the first round could be reconsidered in the second. (Para 69)

We consider that as long as the Challenge Awards Group takes sufficient advice from research councils and sector panels the mechanisms for making the awards should be satisfactory. The Challenge Award scheme is a new mechanism for supporting technology transfer and its operation will be watched with interest. (Para 70)

Industry support for Foresight, and willingness to implement the recommendations emerging from the survey, are likely to be undermined if the Government is not seen to be allocating the resources necessary to ensure the programme is a success. We recommend that future Foresight activity is adequately financed and supported, and that the OST should seek to establish the appropriate level of funding. (Para 73)

We recommend that any future surveys should be given sufficient time to enable a more thorough consultation than was the case on this occasion. (Para 77)

We recommend that if there is any repetition of the Delphi process questionnaires should be more focused both in the questions themselves and in the respondents to whom they are sent; if a wide range of expertise is required it may be necessary to tailor the questions to different groups. It is also important that those asked to expend a considerable amount of time on the questionnaires should have the purpose of the exercise explained more clearly than seemed to be the case. More effort should be expended on ensuring the questionnaires go to younger researchers or those with divergent views. (Para 82)

We recommend that the OST gives serious consideration to the timing of any Delphi questionnaire used in any future Foresight Surveys. Panels should have received the fully analysed results of such questionnaires at an early stage in the survey process. (Para 83)

We recommend that some overview is taken once a decade *at the least*. Although panels may refine their proposals and issue new reports in the intervening period, a large scale survey will bring to light any re-organisation of the panels which may be necessary. Moreover only a large scale survey will provide the overview of scientific and technological possibilities which has been so valuable a result of the first Foresight Survey. (Para 84)

The "Forward Look" should be a key tool in ensuring that the Foresight Programme is in fact implemented. (Para 86)

Given the importance of the "Forward Look", we expect the OST to consult its users, including this Committee, before any major changes are made. (Para 88)

We are deeply dissatisfied by the presentation of information on DTI expenditure on innovation in the DTI Annual Report, the "Forward Look" and in the written evidence we were given. (Para 90)

We accept that it may not be possible for departments to give detailed breakdowns of all categories of future expenditure on science and technology. We nevertheless recommend that, at the least, the OST should require departments to provide those details of planned expenditure which are already available elsewhere. It would also be helpful to have clearer information about the way in which the figures given in the "Forward Look" relate to the figures given in other Government publications such as Departmental Annual Reports. Indeed, we are surprised that this has not already been done. This seems to be evidence that the transdepartmental co-ordination promised in the 1993 White Paper is not working satisfactorily. (Para 91)

We recommend that there should be greater consistency in the presentation of information between departments and in particular that details of funding allocated to schemes such as LINK should be given. (Para 92)

We consider it reasonable to economise on the presentation of information as long as there is no diminution in the document's content. (Para 93)

We trust that complete statistics will be available next year and that the Higher Education

Funding Councils will have a separate entry in the 1996 "Forward Look". The Higher Education Funding Councils provide a significant proportion of science base funding and the universities they support perform the vital task of providing scientific expertise. The document cannot give the overview that is intended without fuller information about the HEFCs. (Para 94)

We again recommend that the OST examine this particular method as a possible way of measuring the success of investment in Research and Development. (Para 95)

We again recommend that figures for BERD by industrial sector be expressed in real terms in next year's "Forward Look". (Para 96)

We recommend that figures giving details of Framework funding received by institutions in the public and private sectors are published each year in the "Forward Look". The OST should also seek to improve the completeness and accuracy of these figures. (Para 97)

We intend to monitor the division made in the attribution of the cost of EU R&D to departments in future. We recommend that this information is given in future editions of the "Forward Look." (Para 98)

The comprehensiveness and clarity of the information contained in future "Forward Looks" will reveal the extent to which the OST can influence other departments. We consider it crucial that the OST is able to ensure that, as the White Paper said, "over time and reinforced by the results of the Technology Foresight Programme ... [the] ... new "Forward Look" will form the basis of better informed decisions between competing priorities, which can inform decisions taken during annual public expenditure surveys." (Para 99)

We recommend that in future the "Forward Look" should be laid before the House. (Para 100)

LIST OF ABBREVIATIONS

AIRTO - Association of Independent Research and Technology Organisations

BERD - Business Enterprise Research and Development

BRE - Building Research Establishment

BT - British Telecommunications

CBI - Confederation of British Industry

CEST - Centre for Exploitation of Science and Technology

CSA - Chief Scientific Adviser

DGRC - Director General of Research Councils

DTI - Department of Trade and Industry

EPSRC - Engineering and Physical Sciences Research Council

HEFCs - Higher Education Funding Councils

NERC - Natural Environment Research Council

NFU - National Farmers Union

OST - Office of Science and Technology

PREST - Policy Research in Engineering, Science and Technology

R&D - Research and Development

ROPAs - Realising our Potential Awards

RTO - Research and Technology Organisation

SET - Science Engineering and Technology

PROCEEDINGS OF THE COMMITTEE RELATING TO THE REPORT

Wednesday 29th November 1995

Members present:

Sir Giles Shaw, in the Chair

Mr Spencer Batiste
Dr Jeremy Bray
Mr Ian Bruce
Mrs Anne Campbell
Dr Lynne Jones
Mr Andrew Miller
Mr Patrick Thompson
Sir Trevor Skeet

The Committee deliberated.

Draft Report (Technology Foresight) proposed by the Chairman, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 6 read and agreed to.

Paragraph 7 postponed.

Paragraph 8 (now paragraph 7) read and agreed to.

Paragraph 9 divided.

Paragraph 9 (now paragraph 8) read and agreed to.

Ordered, that Paragraph 7 be inserted at the beginning of the second part of Paragraph 9.

Paragraph (now paragraph 9) read, amended and agreed to.

Paragraphs 10 to 16 read and agreed to.

Paragraphs 17 and 18 read, amended and agreed to.

Paragraphs 19 and 20 read and agreed to.

Paragraph 21 brought up and read, as follows:

"After OST officials appeared before us we asked for further information about:

—changes in DTI income from and expenditure on research and innovation for the years 1992-93 to 1994-98;

—how the extra £70 million that the DTI has allocated to Foresight and innovation was to be spent and the source of that money;

—why it had been difficult to provide information on European Union Framework Programme funding promised in the Government Response to the Committee's earlier Report on the *Forward Look*; and

—the attribution of EU research funds between individual departments.

> Although the OST had been made aware of the timetable for this inquiry this information was not available until late afternoon on Monday 27th November. Some of the information we required was complex, but, all we assumed, should be readily available. There has been no explanation for the delay. **We have had little time in which to consider the information given and accordingly reserve our judgement. However, we are most concerned at this dilatoriness and consider it raises questions about the Departments' ability to work together."**

Paragraph disagreed to.

Paragraph 22 (now paragraph 21) read and agreed to.

Paragraph 23 (now paragraph 22) read and agreed to.

Paragraphs 24 to 35 (now paragraphs 23 to 34) read and agreed to.

Paragraph 36 (now paragraph 37) read, amended and agreed to.

Paragraphs 37 to 41 (now paragraphs 36 to 40) read and agreed to.

A paragraph — (*The Chairman*) — brought up, read the first and second time and inserted (now paragraph 41).

Paragraphs 42 to 49 read and agreed to.

Paragraph 50 read, amended and agreed to.

Paragraph 51 read and agreed to.

Paragraph 52 read, amended and agreed to.

Paragraphs 53 to 56 read and agreed to.

Paragraph 57 read, amended and agreed to.

Paragraphs 58 to 64 read and agreed to.

Paragraph 65 read, amended and agreed to.

Paragraphs 66 to 68 read and agreed to.

Paragraphs 69 and 70 read, amended and agreed to.

Paragraphs 71 and 72 read and agreed to.

Paragraph 73 read, amended and agreed to.

Paragraphs 74 to 86 read and agreed to.

Four paragraphs — (*The Chairman*) — brought up, read the first and second time and inserted (now paragraphs 87 to 90).

Paragraph 87 (now paragraph 91) read, amended and agreed to.

Paragraph 88 (now paragraph 92) read and agreed to.

Paragraph 89 brought up and read, as follows:

> "The lengthy essays on science and technology subjects, a feature of the 1994 Forward Look, have this year been replaced by briefer descriptions of particular areas of Science and Technology research and policy, under the general headings:

> "SET White Paper in Action" and "Strategic Collaboration in SET between Departments". **We are content with the change in format and accept that the Forward Look will inevitably evolve further."**

Paragraph disagreed to.

Paragraphs 90 to 93 (now paragraphs 93 to 96) read and agreed to.

Paragraph 94 (now paragraph 97) read, amended and agreed to.

A paragraph — (*The Chairman*) — brought up, read the first and second time, amended and inserted (now paragraph 98).

Paragraph 95 (now paragraph 99) read, amended and agreed to.

Paragraph 96 (now paragraph 100) read and agreed to.

Resolved, That the Report, as amended, be the First Report of the Committee to the House.

Ordered, That the Chairman do make the Report to the House.

Ordered, That the Appendices to the Minutes of Evidence taken before the Committee be reported to the House. - (*The Chairman.*)

Several Memoranda were ordered to be reported to the House.

[Adjourned till Wednesday 16th December at Four o'clock.

LIST OF WITNESSES

VOLUME II

Wednesday 24 October 1995

DEPARTMENT OF TRADE AND INDUSTRY

Rt Hon Ian Lang MP, President of the Board of Trade

Mr Ian Taylor MP, Minister for Science & Technology

Professor Sir John Cadogan, Director General of the Research Councils

Professor Robert May, Government Chief Scientific Adviser

Wednesday 25 October 1995

CENTRE FOR THE EXPLOITATION OF SCIENCE AND TECHNOLOGY

Dr Robert Whelan, Chief Executive

Dr Michael Elves, Chairman of CEST's Technology Foresight Committee

THE ROYAL INSTITUTION OF GREAT BRITAIN

Professor Peter Day FRS, Director of the Royal Institution of Great Britain

Wednesday 1st November 1995

Professor Sir Geoffrey Allen, FRS

Mr Stewart Miller, Director, Engineering and Technology, Rolls Royce

Mr John Bennett, Director General, Association of Independent Research and Technology Organisations

OFFICE OF SCIENCE AND TECHNOLOGY

Mrs Helen Williams, Head of Transdepartmental Science and Technology Group

Mr Ian Freeman, Head of the Foresight Branch

Dr Richard King, Head of Technology and Innovation Policy
Branch 1 Division, DTI

Wednesday 22 November 1995

ENGINEERING AND PHYSICAL SCIENCES RESEARCH COUNCIL

Dr Alan Rudge, Chairman of the Engineering and Physical Sciences Research Council (EPSRC) and Deputy Group Managing Director, BT.

Dr David Clark, Director of Planning and Communications, EPSRC

CONFEDERATION OF BRITISH INDUSTRY

Dr Brian Eyre, Chief Executive, AEA Technology

Mr Stewart Judd

Dr Philip Wright, Secretary to the CBI Technology and Innovation Committee

LIST OF MEMORANDA INCLUDED IN THE MINUTES OF EVIDENCE

VOLUME II

1. Memorandum from the Office of Science and Technology (TFC 61)

2. Memorandum from the Centre for the Exploitation of Science and Technology (TFC 42).

3. Memorandum from Professor Peter Day, Director of the Royal Institution of Great Britain (TFC 10)

4. Letter to the Clerk of the Committee from the Office of Science and Technology (TFD 79)

5. Memorandum from the CBI (TFC 53)

LIST OF MEMORANDA

VOLUME II

Press release issued by the Committee inviting written submissions

1. Letter from J Sainsbury's plc (TFC 1)
2. Letter from Shorts Missile Systems Ltd (TFC 2)
3. Letter from Rank Xerox (TFC 3)
4. Letter from the Machine Tool Technologies Association (TFC 4)
5. Letter from RHM Technology Limited (TFC 5)
6. Letter from the Institution of Mechanical Engineers (TFC 6)
7. Letter from the Royal Society of Medicine (TFC 7)
8. Letter from IBM UK Laboratories Ltd (TFC 8)
9. Letter from Sharp Laboratories of Europe Ltd (TFC 9)
10. Letter from BTR plc (TFC 12)
11. Letter from The Association of Clinical Biochemists (TFC 13)
12. Memorandum from The Royal Society of Chemistry (TFC 14)
13. The British Plastics Federation (TFC 16)
14. Letter from BNR Europe Limited (TFC 17)
15. Letter from The Babraham Institute (TFC 18)
16. Letter from the ESRC (TFC 19)
17. Letter from Raychem Ltd (TFC 20)
18. Letter from The Geological Society (TFC 21)
19. Letter from the EPSRC (TFC 22)
20. Letter from the Welsh Funding Councils (TFC 23)
21. Memorandum from the National Grid Company plc (TFC 25)
22. Memorandum from the IPMS (TFC 26)
23. Letter from Kellogg's (TFC 27)
24. Memorandum from The Institute of Materials (TFC 28)
25. Memorandum from the Construction Industry Council (TFC 29)
26. Memorandum from The Institute of Physics (TFC 30)

27. Memorandum from the Institution of Electrical Engineers (TFC 31)

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UNPRINTED MEMORANDA

Additional memoranda have been received by the following and have been reported to the House, but to save printing costs they have not been printed and copies have been placed in the House of Commons Library where they may be inspected by Members. Other copies are in the Record Office, House of Lords, and are available to the public for inspection. Requests for inspection should be addressed to the Record Office, House of Lords, London, SW1. (Tel 071-219 3074). Hours of inspection are from 9.30 am to 5.30 pm on Mondays to Fridays.

Ricardo Engineering (TFC 11)

EEC International Europe (TFC 15)

Institution of Nuclear Engineers (TFC 24)

Conoco Ltd (TFC 41)

Addendum to the CBI's memorandum (TFC 53)

Other Papers

Letter to the Chairman of the Committee from the Prime Minister

Letter from Professor Sir John Cadogan, the Director General of Research Councils

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